

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau

## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b>  <b>F16K 31/26</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 99/14523</b>  <b>(43) International Publication Date:</b> 25 March 1999 (25.03.99)																								
<b>(21) International Application Number:</b> PCT/HU98/00084  <b>(22) International Filing Date:</b> 14 September 1998 (14.09.98)  <b>(30) Priority Data:</b> <table border="0"> <tr> <td>P 97 01533</td> <td>12 September 1997 (12.09.97)</td> <td>HU</td> </tr> <tr> <td>P 97 01534</td> <td>12 September 1997 (12.09.97)</td> <td>HU</td> </tr> <tr> <td>P 97 02556</td> <td>31 December 1997 (31.12.97)</td> <td>HU</td> </tr> <tr> <td>P 97 02557</td> <td>31 December 1997 (31.12.97)</td> <td>HU</td> </tr> <tr> <td>P 97 02558</td> <td>31 December 1997 (31.12.97)</td> <td>HU</td> </tr> <tr> <td>P 98 00375</td> <td>23 February 1998 (23.02.98)</td> <td>HU</td> </tr> <tr> <td>P 98 01787</td> <td>4 August 1998 (04.08.98)</td> <td>HU</td> </tr> <tr> <td>P 98 01788</td> <td>4 August 1998 (04.08.98)</td> <td>HU</td> </tr> </table>  <b>(71)(72) Applicant and Inventor:</b> BEREZNAI, József [HU/HU]; Gát u. 8. 2/21, H-1095 Budapest (HU).  <b>(74) Agent:</b> GÖDÖLLE, KÉKES, MÉSZÁROS & SZABÓ; Keleti Károly u. 13/b, H-1024 Budapest (HU).		P 97 01533	12 September 1997 (12.09.97)	HU	P 97 01534	12 September 1997 (12.09.97)	HU	P 97 02556	31 December 1997 (31.12.97)	HU	P 97 02557	31 December 1997 (31.12.97)	HU	P 97 02558	31 December 1997 (31.12.97)	HU	P 98 00375	23 February 1998 (23.02.98)	HU	P 98 01787	4 August 1998 (04.08.98)	HU	P 98 01788	4 August 1998 (04.08.98)	HU	<b>(81) Designated States:</b> AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>
P 97 01533	12 September 1997 (12.09.97)	HU																								
P 97 01534	12 September 1997 (12.09.97)	HU																								
P 97 02556	31 December 1997 (31.12.97)	HU																								
P 97 02557	31 December 1997 (31.12.97)	HU																								
P 97 02558	31 December 1997 (31.12.97)	HU																								
P 98 00375	23 February 1998 (23.02.98)	HU																								
P 98 01787	4 August 1998 (04.08.98)	HU																								
P 98 01788	4 August 1998 (04.08.98)	HU																								
<b>(54) Title:</b> BALANCE FLOAT CONTROLLED VALVE ASSEMBLY																										
<b>(57) Abstract</b>																										
<p>The balance float (1) controlled valve assembly of the invention includes at least one valve means (2), a liquid receptacle (4), and at least one balance float (1) connected via a link (5) to a rotatable free end of a pivoted balance lever (31). The valve means (2) comprises a closure member having a valve shaft (25) that is slideably guided between a first end position and a second end position. The valve assembly further includes a mechanism (3) that is arranged between the balance lever (31) and the valve shaft (25) of the closure member of the valve means (2). The mechanism (3) is designed so as to having and staying in an approximately self-locked state when the valve shaft (25) of the closure member of the valve means (2) stays in its first end position. The approximately self-locked state of the mechanism (3) is substantially resistant to forces biasing the valve shaft (25) towards its second end position in the sense of closing the thoroughfare flow passage through the valve means (2), but the approximately self-locked state of the mechanism (3) is easily and rapidly released by the balance lever (31) when the torque exerted onto the balance lever (31) by the weight of the balance float (1) is reduced, and the balance lever (31) is lifted and turned in a direction opposite to the torque exerted thereon by the balance float (1).</p>																										

*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

WO 99/14523

PCT/HU98/00084

## Balance float controlled valve assembly

### Technical Field

The present invention relates to float controlled valve assemblies which include at least one valve means installed into a liquid flow, especially into a pipeline or a pipeline armature and a liquid receptacle that is fed with at least a part of a liquid flowing through the valve means or escaping, as a result of a sealing failure, from a liquid supply system including said at least one valve means. The valve assembly further includes at least one balance float connected to a rotatable free end of a pivoted balance lever. The at least one balance float stays above the current liquid level of the liquid in the receptacle while said liquid level is below a pre-determined or permitted level while the balance float immerses, at least partially, into the liquid contained in the receptacle when said liquid level reaches or exceeds said pre-determined or permitted level in the liquid receptacle. The valve means of the valve assembly comprises a flow passage determined by a valve seat that is arranged between a pressure chamber and an outlet chamber of the valve means. The valve means also comprises a piston-like closure member having a valve shaft and a piston head at one end of the valve shaft. The valve shaft is slideably guided between a first end position and a second end position. The closure member maintains a thoroughfare flow passage through the valve means in the first end position of the valve shaft, and the closure member closes the flow passage through the valve means when the valve shaft is moved to its other, second end position. The piston head of the closure member is arranged within the pressure chamber of the valve means, and the valve assembly further includes a mechanism arranged between the balance lever and the valve shaft of the closure member of the valve means.

WO 99/14523

PCT/HU98/00084

- 2 -

## Background Art

It is a common characteristic of most hitherto known float controlled valve assemblies used for monitoring and influencing the liquid level of receptacles that a flow passage of a valve means is altered by a displaceable closure member. The closure member is generally movable between two end positions associated with an open and a closed state of the valve means, respectively. Such known valve assemblies also have a definite mechanical linkage between the float and the closure member of the valve means which is moved, at least in certain phases of the changes in the liquid level of the receptacle, by the float. A known valve assembly of the kind indicated is described for example in the US Patent No. 5,072,751, where a float is secured to the end of a longer arm of a single-arm lever capable of tilting around a fulcrum secured to a valve housing, and the closure member of the valve is assigned to the end of a shorter arm of the single-arm lever in a way that an upper end of the closure member is permanently pressed by the pressure of water flowing across the valve against the lever while said lever is driven between its two end positions by the float in both directions. As a result of this, during filling up or refilling the receptacle after discharge, the movement of the closure member in the closing direction of the valve slows down gradually and proportionally to the gradually slowing rate of the rise of the float. Thus, the time period needed for filling or refilling the receptacle is extremely long, and the closure member of the valve narrowing the flow passage of the valve gradually over such long periods of time, as well as the co-acting valve seat are subject to rapid wear. This is an inherent and major disadvantage of the type of known valve assemblies referred to and dealt with e.g. in US Patent No. 5,072,751.

US Patent No. 5,067,517 discloses a valve assembly primarily for preventing the overflow of bath tubs and basins, and for pre-selecting the liquid volume to be filled into a bath tub or basin. The valve assembly can be mounted onto the discharge orifice of a valve battery or a water tap, and it includes a float hanging down to a pre-selected and adjustable level into the receptacle to be filled. The closure element of a valve means of the valve is a ball that is located in a pressure chamber of the valve. When the ball sits in a conically shaped annular valve seat

WO 99/14523

PCT/HU98/00084

- 3 -

located at the bottom of the valve chamber, it seals the flow passage through the valve whereby the valve is in its closed state. A pin preventing the ball from sitting sealongly in the conically shaped annular valve seat can be pushed against the force of a pre-stressed spring into the pressure chamber from a radial direction, and in this pushed-in position of the pin, the valve is in its open, thoroughfare state. The pin is locked in its pushed in position by a spring-biassed balance lever as long as a float suspended from the end of the balance lever stays above the gradually rising water level of the receptacle, especially of the bath tub and thus, the float acts on said balance lever with the torque of its full weight. When the rising water level reaches the float and the float starts to become immersed into the water, the float gradually loses its weight, and the torque acting on the balance lever is gradually reduced. As a result of this, the spring-biassed balance lever becomes disengaged from the pin. The compression spring removes the pin from the valve chamber, and the ball returns into the conically shaped annular valve seat whereby the flow passage of the valve becomes sealingly closed again. In this known valve assembly, the rate of the valve closing is no more depending on the rate at which the water level changes, and the rate of valve closing is also independent from the displacement rate of the float. A major disadvantage of this known valve assembly is however, seen in that the valve can only be used in vertical installations. For re-opening the valve, the radial pin must be reset manually into its locked position in which the pin protrudes into the pressure chamber. Consequently, this well known valve assembly is only suitable for automatically closing the valve when a pre-determined or a maximum allowable water level is reached in the bath tub or other receptacle.

#### Summary of the Invention

One object of the present invention is to provide a float controlled valve assembly, in which the rate of the closing and opening displacement of a closure member of the valve is not subject in any of the two directions, to the rate of the movement of the float, and which is, by appropriate dimensioning, suitable for both, the float controlled closing and re-opening of the valve.

WO 99/14523

PCT/HU98/00084

- 4 -

Another objective of the present invention is the provision of a float controlled valve assembly, which enables the actuation of valves of large flow passages, even of valves of industrial sizes, by at least one relatively low weight float, whereby the valve assembly can also be used in industrial applications for automatically controlling the liquid level in all kinds of receptacles.

A yet another object of the present invention is to provide a valve assembly which also allows for a float controlled operation of valves that are located distantly from the liquid receptacle and thus, from the float associated therewith.

Finally, a further object of the invention lies in the provision of a float controlled valve assembly suitable for monitoring liquid, especially water supply systems of rooms, buildings, industrial plants and workshops, and for automatically closing the liquid, especially water supply when a leakage of the liquid or flooding resulting from pipe breakage or another sealing failure is detected.

In accordance with the above and other objects, the valve assembly of the present invention and having the characteristic features listed and described in the introductory part of the present description is characterised by a novel mechanism that is in accordance with the spirit of the invention, designed so as to having and staying in an at least approximately self-locked state when the valve shaft of the closure member of the valve means of the valve assembly stays in its first end position, the at least approximately self-locked state of the mechanism being substantially resistant to forces exerted onto and biasing the valve shaft-towards its second end position in the sense of closing the thoroughfare flow passage through the valve means but the at least approximately self-locked state of the mechanism being easily releasable by the balance lever when the torque exerted onto the balance lever by the weight of the at least one balance float is slightly reduced, and the balance lever is lifted and turned in a direction opposite to the torque exerted thereon by the at least one balance float.

Preferred embodiments of the valve assembly according to the invention may include at least one balance float having a density that is identical with or is lower or higher than that of the liquid. The at least one balance float can be divided into several internal compartments or sections. The internal compartments or sections of

WO 99/14523

PCT/HU98/00084

- 5 -

the at least one balance float can be made of or filled in with different structural materials of different density.

In certain preferred embodiments of the valve assembly of the invention the at least one balance float may be linked to the rotatable free end of the balance lever by means of a preferably flexible link suitable for bearing and transferring tensile load only, and the mechanism may also include an energy-storing spring means, preferably at least one pre-tensioned compression spring biasing the closure member of the valve means in the direction of its second end position corresponding to the closed state of said valve means.

In yet other preferred embodiments of the valve assembly according to the invention the at least one balance float can be arranged at any suitable location relative to the at least one valve means, the at least one balance float can be suspended above the liquid receptacle in adjustable relation thereto, and several balance floats arranged optionally on and held by the same link can be positioned at adjustable distances in relation to both, each other and the receptacle.

#### Brief Description of the Drawings

Other features and advantages of the valve assembly according to the present invention will become apparent in the following detailed description of preferred embodiments with reference to the accompanying drawings, of which

Figs. 1A and 1B are sketches showing in the open and closed positions of the valve means, respectively, the schematic design and mode of operation of a first embodiment of the invention in which a valve means is controlled by a suspended single balance float,

Figs. 2A and 2B are simplified sketches of another preferred embodiment wherein a valve means is controlled by two balance floats hanging on the same link, and wherein the valve assembly is shown again in the open and closed positions of the valve means, respectively,

Fig. 3A is a front view of the valve means of another embodiment of the invention which can be fitted to replace a flow strainer of a bath tub



WO 99/14523

PCT/HU98/00084

- 6 -

valve battery or any other water tap in order to prevent the overflow of a bath tub, hand-wash basin, pool or any other liquid receptacle,

Fig. 3B is a simplified sketch depicting the schematic internal design and mode of operation of the embodiment shown in Fig. 3A,

Figs. 4A to 7B are, by way of examples only, schematic kinematic sketches of preferred mechanisms of the valve assembly of the invention, where in Figs. \*A the valve means is shown in its open state, while Figs. \*B depict the valve means of the assembly in its closed state,

Figs. 8A to 10B illustrate, partly in sectional views, preferred examples of embodiments of the valve assembly of the invention, which can be mounted into a delivery duct or also on the outlet (discharge) orifice of various water taps, where Figs. \*A again, show the open, flow-through condition of the valve means, while Figs\*. B depict the valve means in its closed state,

Figs. 11A and 11B are partly sectional views of an embodiment mounted into the valve battery of a bath tub. The figs. show again the valve means in its states of passing through and blocking the flow of water, respectively,

Figs. 12 and 13 show further implementation examples which can be installed, preferably, in a bathroom valve battery,

Fig. 14 is a longitudinal sectional view of a float mount example suitable for holding a balance float on a flexible link in an adjustable manner,

Fig. 15 is the side view of a water tap which includes an embodiment of the valve assembly embodying the invention,

Fig. 16 is the sectional view of a further implementation example using a valve means mouted and located behind the wall plane,

Fig. 17 is a top view of another valve assembly illustrating the a possibility of operating two valve means by a single balance lever,

Fig. 18 is a simplified sketch of a valve aassembly example embodying the invention, wherein two valve means are again, controlled by a single balance lever,

WO 99/14523

PCT/HU98/00084

- 7 -

Figs. 19A to 19C are sketches showing in different (closed, intermediate and opened) states of operation of a piston head of the piston-like closure member of a valve assembly, in which the valve means is suitable for implementing a multi-stage valve opening. This embodiment can be used beneficially especially in valve means of valve assemblies of the invention, by which a large size flow passage is controlled at high pressure, mainly in industrial applications,

Fig. 20 is a sketch illustrating, as an example only, the schematic structure of a valve assembly of the invention, which can be installed in a concealed, hidden way behind the wall plane, and which allows for filling additional amounts of liquid in a receptacle, especially bath tub,

Fig. 21 is a sketch depicting one preferred field of application, by way of example only, of the valve assembly of the invention in which the invention is used as „flood guard” for preventing the flooding of buildings/premises,

Fig. 22 illustrates a different example of the installation of the „flood guard” shown in Fig. 21 and

Fig. 23 depicts an implementation example showing installation possibilities of another embodiment of the invention as a „flood guard” again, by which a liquid, especially water supply system in a multi-storey building is monitored, preferably on each floor, and which automatically closes the liquid delivery duct or certain branches thereof, when leakage of liquid, especially water is detected.

### Modes for Carrying Out the Invention

A first embodiment of the valve assembly according to the invention shown, by way of example only, in open and closed valve means positions in the schematic diagrams of Figs. 1A and 1B, respectively, includes a valve means 2 mounted into the pipeline or pipeline armature (not shown in the drawing). The valve assembly further includes a liquid receptacle 4 supplied by liquid flowing through the valve

WO 99/14523

PCT/HU98/00084

- 8 -

means 2 in its open valve position, and a balance float 1 which is connected via a flexible link 5 to a rotatable free end of a pivoted balance lever 31. The balance float 1 is to a greater part immersed into a liquid contained in the liquid receptacle 4 when its liquid level has reached a pre-determined or permitted upper UL liquid level (Fig. 1B). Otherwise, the balance float 1 stays to a greater part above the current liquid level of the liquid receptacle 4 while the liquid level is lower than pre-determined or permitted (Fig. 1A). Between a pressure chamber 21 and an outlet chamber 22 of the valve means 2 there is flow passage 20 determined by a valve seat, and the flow passage 20 is sealingly closeable by a piston head 24 of a piston-like closure member 23, a valve shaft 25 of which is slideably guided and thus, the piston head is movable between two end positions. In its first end position the valve head 24 keeps open the flow passage 20 of the valve means whereby the flow of liquid through the latter is allowed. The piston head 24 seals the flow passage 20 of valve means 2 in its other, second end position whereby the flow of the liquid through valve means 2 is blocked. The piston head 24 of the piston-like closure member 23 is located in the pressure chamber 21 of the valve means 2. Between the balance lever 31 and the valve shaft 25 there is an actuating mechanism 3 which is, when the piston-like closure member 23 is in its first, open valve end position (Fig 1A) in an at least approximately self-locked state in which the mechanism 3 is substantially resistant to forces exerted onto and biasing the valve shaft 25 towards its second end position in the sense of closing the thoroughfare flow passage through the valve means 2. The joint forces acting on the closure member 23 result from the (differential) pressure of the liquid acting on piston head 24 and the force of a pre-tensioned and energy storing compression spring 30. As a result of the design and dimensioning of the component parts of mechanism 3, in such a substantially self-locked state, an angle  $\alpha_1$  between a coupling link 32 and the balance lever 31 of mechanism 3 is almost  $180^\circ$ , consequently the above mentioned components of the mechanism 3 are almost aligned. This self-locked state of the mechanism 3 can be easily and steadily maintained by a very low torque load acting on the balance lever 31 even by a low weight balance float 1 staying, at least partially, above the pre-determined liquid

WO 99/14523

PCT/HU98/00084

- 9 -

level of the liquid receptacle 4. Consequently, if the liquid in the receptacle 4 does not reach or exceed the upper liquid level UL specified or permitted by the (alterable) suspension height of the balance float 1, the valve means 2 remains steadily in the open valve position shown in Fig. 1A. The at least approximately self-locked state of the mechanism 3 is, however, easily releasable when the torque exerted onto the balance lever 31 by the weight of the balance float 1 is slightly reduced, and the balance lever 31 is lifted and turned in a direction opposite to the torque exerted thereon by balance float 1. Thus, when the liquid level in the liquid receptacle 4 rises as shown by arrow  $h$  in Fig. 1A, the balance float 1 which preferably has a density not significantly differing from that of the liquid, is gradually immersed into the liquid, and as a result of the buoyant force, its weight decreases slightly. Consequently, the torque loading the balance lever 31 is also reduced. As a result of the design and dimensioning of mechanism 3, even when this torque is reduced very slightly, this slight decrease of torque is sufficient to release the self-locked state of the mechanism 3 shown in Fig. 1A, by virtue of which the joint hinging point of balance lever 31 and coupling link 32 is moved upwards, angle  $\alpha_1$  starts to decrease rapidly, and the force acting against the joint force of the liquid pressure acting on piston head 25 of the closure member 23 and the energy stored in compression spring 30 decreases dramatically. As a result of this, the piston-like closure member 23 virtually jumps with an accelerating motion into its other, second end position, and the piston head 24 closes the flow passage 20 of valve means 2, as shown in Fig 1B. The closed valve state is steadily maintained by the liquid pressure acting on the total surface of piston head 24 compensating the force decrease in compression spring 30 which has occurred as a result of the displacement, while the mechanism 3 is practically released from load. After a very slight displacement of the balance lever 31, which releases the self-locked state of the mechanism 3, the speed of the remaining valve closing motion does no more depend on the weight of balance float 1 and thank to the design of mechanism 3, the valve assembly embodying the invention is suitable to actuate almost any, even industrial size valve means 2 of considerable flow passage 20 by using a low weight and small size balance float 1. The embodiments of the valve

WO 99/14523

PCT/HU98/00084

- 10 -

assembly of the invention shown in Figs. 1A and 1B, are generally designed and dimensioned so that the increasing torque acting on balance lever 31 through the weight of the preferably low weight balance float 1 in the way already mentioned when the buoyant force no longer acts on balance float 1, cannot reset the valve means 2 to its open position without external intervention, even when the liquid level decreases in liquid receptacle 4. The main field of application of such valve assemblies is generally the water-saving operation of any type of liquid receptacle 4 generally, including but not limited to bath tubs, basins (pools) etc., by making sure that the valve assembly embodying the invention and associated with the valve battery/water tap filling the same closes the flow of water when a pre-determined water level in the receptacle is reached, even if the filling tap is left open accidentally. Once the tendency to overflow has been detected, the closure member 23 of valve means 2 of the valve assembly that has been moved into its closed position by the balance float 1 automatically, can be reset to its open valve position shown in Fig. 1A for example by pulling the flexible link 5 (chain, cord etc.) or by turning the balance lever 31 or an associated auxiliary lever (not shown) manually, following which the filling tap left open can also be turned off.

In Figs. 2A and 2B of the drawing, only as an example, another embodiment of the valve assembly of the invention and described above is shown, which includes two balance floats 1a and 1b arranged on the same flexible link 5 one below the other in alterable and adjustable heights relative to both, the liquid receptacle 4 and each other. Subject to appropriate dimensioning, the balance floats 1a and 1b of this embodiment of the invention are suitable for controlled actuating the mechanism 3, and thereby the piston-like closure member 23 of valve means 2, in both directions. Thus, the liquid volume in the liquid receptacle 4 is maintained even without manual intervention, between two pre-determined liquid levels, as indicated in the drawing figures by upper level UL and lower level LL. To this end, it has been proved to be appropriate to choose the density of the material of the lower balance float 1b to be nearly identical with that of the liquid. When after immersion, balance float 1b is floating in the liquid, it would not influence the torque acting on the balance lever 31. The density of the upper balance float 1a can be lower than that of the liquid. When it is immersed even slightly, it starts to float

WO 99/14523

PCT/HU98/00084

- 11 -

by rapidly losing the force of gravity, whereby the switching hysteresis of the valve assembly can be kept conveniently low. In the state of operation depicted in Fig. 2B, a lower outlet valve 41 of the liquid receptacle 4 is closed, valve means 2 is in the open position, and the liquid level in the liquid receptacle 4 rises as indicated by arrow h. The lower balance float 1b floating in the liquid does not have any effect on the system, and the upper balance float 1a acts on the balance lever 31 with its total weight. When the liquid in the receptacle 4 reaches the upper level UL, the balance float 1a is floating and loses its weight, and as already described above with reference to drawing Figs. 1A and 1B, the rapid closing of valve means 2 takes place, and the liquid level stoppes to rise further. If outlet valve 41 is opened, the liquid level in liquid receptacle 4 starts to decrease, as shown by arrow k in Fig 2B. In a way already mentioned above, the upper balance float 1A gradually leaves the liquid, and it regains its weight. Its additional torque however, is not yet sufficient to reset the piston-like closure member 23 of the valve means 2 by the compression spring 30 against liquid pressure acting on piston head 24 to its first end position corresponding to the open valve status. In the course of the further reduction of the liquid level however, also the lower (and heavier) balance float 1b gradually leaves the liquid, and its force of gravity is substantially regained when reaching the lower liquid level LL is, added to the weight of balance float 1a. already sufficient enough to reset the open valve position of valve means 2 as shown in Fig 2A. Hereafter, when outlet valve 41 is closed, or the flow of liquid escaping through the latter is smaller than that of the liquid flowing in receptacle 4 through valve means 2, the liquid level in the liquid receptacle 4 starts to rise again, and it gradually rises as long as it reaches the upper liquid level UL. Consequently, by using the valve assembly of the invention, an automatic level control between even extremely wide liquid level limits can be performed and maintained.

The link connecting the balance float(s) 1, 1a, 1b to the balance lever 31 is by no means an essential characteristic feature of the valve assembly of the invention. The use of any link 5 suitable for transferring load in both directions such as a rod, or a rigid coupling of at least one of the balance floats 1, 1a or 1b directly to the free end of a balance lever 31 immersible in the liquid receptacle 4, could be especially advantageous for designing valve assemblies capable of moving

WO 99/14523

PCT/HU98/00084

- 12 -

automatically and with high reliability the valve means 2 between its appropriate open and closed positions when pre-determined lower and upper liquid levels in the receptacle 4 are reached.

As mentioned already further above, balance floats 1, 1a, 1b having a density that is identical with or lower or higher than that of the liquid can also be used in the assembly. Balance floats 1, 1a, 1b of a density identical with that of the liquid can simply be filled even with the liquid itself. The balance floats 1, 1a, 1b can optionally be divided into several internal compartments or sections, and the internal compartments or sections of the balance float 1, 1a, 1b can be made of or filled in with different structural materials of different density. The balance floats of the assembly can also be designed so as to be of special shape and internal weight distribution. Such balance floats would change their weight as a function of their depth of immersion in a desired and specified way. By doing so, the change in the force of gravity of a balance float immersed into or rising from the liquid can be specified according to any desired programme. The internal weight distribution changing in a specified way can be implemented advantageously for example in a single float body having several internal compartments, with a structural material differing in each compartment or filled up with materials of different density in each compartment, as already mentioned further above. With reference to the embodiment shown in Figs. 2A and 2B of the attached drawing, such balance floats may for example replace the two balance floats 1a and 1b of different density and weight by a single "combined float" of changing density in applications where only a slight and constant level difference is pre-determined or permitted between the upper and lower liquid levels UL and LL.

In Fig. 3A a particular preferred embodiment of the valve means of the invention is shown which can be preferably mounted, replacing the flow strainer, onto the threaded discharge orifice of a valve battery or a different water tap in order to prevent the overflow of a bath tub, a hand-wash basin, a pool or any other liquid receptacle. As shown in the drawing figure, here the balance lever 31 is designed as a single-arm lever increasing the ratio of transmission, the fulcrum of which is arranged on a casing of valve means 2. The coupling link 32 is linked to the shorter arm section of the single-arm lever, while the balance float (not shown

WO 99/14523

PCT/HU98/00084

- 13 -

in the figure) is via a link 5 designed in the embodiment shown as a small-bead chain linked to the longer arm section of the single-arm lever at the free end of the balance lever 31. In the drawing figure, full lines show the positions of the above mentioned components of the mechanism 3 in the open valve state, while dotted lines depict their status in the closed valve position. The valve housing and most mechanism component parts of the valve assembly can be covered with an aesthetic casing 27 also shown with dotted lines in the drawing figure, and the original strainer 28 of the valve battery or any different type of water tap can be fitted to a threaded discharge stub of valve means 2. With commercially available embodiments of the valve assembly of the invention preferably an adapter set is supplied which enables its mounting to various existing standard taps and valve batteries. In the embodiment shown, the casing 27 of the valve assembly may also include sound signal device which provides an audible warning when the valve means 2 is switched to its closed position (when for example the bath tub is full). The internal conceptual design allowing to describe the mode of operation of the valve assembly embodying the invention shown in Fig. 3A is depicted in Fig. 3B, in which the valve means 2 is shown in its open state. The positions of coupling link 32 and balance lever 31 of the mechanism 3 and those of balance float 1 and flexible link 5 in this open valve state are shown by continuous, full lines, while the other positions of the structural elements listed (when the valve is closed) are depicted by dotted lines. The mode of operation of the valve assembly is exactly identical with that of the embodiment shown in Figs. 1A and 1B, so its detailed description will not be repeated here.

Again by way of examples only, Figs 4A to 7B of the attached drawing show schematic kinematic sketches of various preferred mechanisms 3 suitable for the practical implementation of the valve assembly embodying the invention. Figs. \*A depict the open, thoroughfare state of the valve assembly, while Figs. \*B show the valve assembly in its other state when it blocks the flow of liquid. It can be seen in the drawing figures that angle  $\alpha_1$  characteristic of the self-locked status of each mechanism 3 is considerably larger in the open thoroughfare status of the valve means 2 than angle  $\alpha_2$  prevailing and shown in the figures illustrating the closed state of valve means 2. It seems to be of importance to note that though all



WO 99/14523

PCT/HU98/00084

- 14 -

examples shown include a compression spring 30, the valve assembly having an energy storing spring member is not an essential characteristic feature of the invention. Valve assemblies with a mechanism having no spring member can preferably be controlled and actuated by at least one balance float of the "combined" type referred to further above, which balance float is rigidly coupled to the free end of the balance lever, and has at least one inner compartment the density of which is lower than that of the liquid.

Figs. 4A and 4B indicate a mechanism 3 having a coupling link 32 connected to an angled two-arm balance lever 31. The mechanism 3 shown in Figs. 5A and 5B has an angled two-arm balance lever 31. One of its arms is designed as a slotted link bar 33 which is linked to a pin of the valve shaft 25 of valve means 2 whereby a relative slipping motion between the slotted link bar of the balance lever 31 and the valve shaft 25 is allowed for. The balance lever 31 of the mechanism 3 according to Figs. 6A and 6B is again an angle lever, which is joined in a fulcrum to the valve shaft 25 of valve means 2. The balance float 1 is suspended from (or rigidly fixed to) the free end of one arm of the angle lever, while at the end of the other arm of the angle lever a roller 34 capable of freely rolling on a support surface 35 is arranged. It is noted here that the self-locked and release characteristics of such mechanisms 3 can be influenced and further improved by designing and using a support surface 35 of a shape other than a flat plane. The mechanism shown in Figs. 7A and 7B includes a cam disc 36 connected rigidly to the balance lever 31 and co-acting with a roller 34 arranged, freely rotatably again, on the valve shaft 25 of the valve means 2. In addition to those shown in the drawing figures, also other types of well known mechanisms can be properly designed and used for valve assemblies of the invention.

Figs. 8A to 10B show preferred implementation examples of the valve assembly embodying the invention. The embodiments shown can be installed into a delivery duct, and can also be attached to the discharge orifice of various water taps. Again, Figs. \*A show the open thoroughfare state of valve means 2 of the valve assembly, while Figs. \*B depict the valve means 2 in its closed state of operation. The mechanism 3 of the valve assembly shown in Figs. 8A and 8B makes use of the design shown and described conceptually earlier with reference to

WO 99/14523

PCT/HU98/00084

- 15 -

Figs. 5A and 5B. The valve assembly shown in Figs. 9A and 9B includes one version of the support roller mechanism 3 depicted in Figs. 6A and 6B, while the mechanism 3 of the valve assembly shown in Figs. 10A and 10B is a suitably adapted version of a mechanism using a coupling link 32. Concerning the valve assembly shown in Figs. 9A and 9B it should be noted that if a bushing 37 guiding in a sealed way, the valve shaft 25 of the valve means 2 is fitted into the casing of valve means 2 in a way that the fit allows for the rotation of the bushing 37 around the centreline of the valve shaft 27, and the axial fixing of the bushing 37 in the valve housing is provided for, the balance lever 31 can be rotated, together with the link 5 secured to its end and with the balance float 1 arranged on the link 5, around the centreline of the valve shaft 25. Thus, the balance lever 31 and the component parts attached thereto can always be adjusted to a position which is the most comfortable and ensures the least interference in use. If the support roller mechanism 3 shown in Figs. 9A and 9B is used for a vertically installed valve assembly, the same effect can be accomplished even by using a fixed and stationary bushing 37.

If as it will be dealt with later, a valve assembly according to the invention is connected to or installed in the discharge orifice of a liquid valve or tap, in the simultaneously closed position of the valve means 2 of the valve assembly and with the liquid valve or tap directly fitted upstream of the pressure chamber 21 of the valve 21, the pressure chamber 21 of the valve means 2 is filled up with a liquid volume theoretically incompressible, which prevents but at least makes it difficult for the piston head 24 of the valve means 2 to be displaced against the liquid pressure, whereby the opening of the valve means 2 is prevented or at least constrained. For eliminating this phenomenon, it has proven to be advantageous to arrange a deformable structural element of capable of elastic deformation, preferably a lining or a sleeve 26 in or near to the pressure chamber 21 of the valve 2, or elsewhere in the space filled up with the enclosed liquid, for example in a directly linked delivery duct section or armature element, as shown clearly in Figs. 9A and 9B of the attached drawing. The elastic deformable, especially compressible sleeve 26 enables a slight increase of the volume of the enclosed space, thereby facilitating the initial (opening) displacement of the piston head 24 of the valve

WO 99/14523

PCT/HU98/00084

- 16 -

means 2. In addition, the sleeve 26 of elastic deformation also reduces and virtually eliminates the operating noise of valve means 2.

Figs. 11A to 13 show some further preferred embodiments of the valve assembly of the invention installed in an integrated way into a valve battery 6 of a bath tub, by way of example only. Figs. 11A and 11B show the same embodiment of the valve assembly in its open and closed valve state, respectively. The mechanism 3 of the embodiment shown has a balance lever 31 designed as a slotted link bar. Fig. 12 shows another possible arrangement of the actuating lever 31 in respect to the discharge orifice 61 of the valve battery 6, and Fig. 13 indicates an upper arrangement of a support roller actuating lever 31 version in an open valve position. As already referred to earlier, the actuating lever 31 of the embodiment shown in Fig. 13 can be almost fully turned round the valve shaft axis which is vertical in this case, whereby it can be set to suitable operating positions. As further shown in Fig. 13, the link 5 of the balance float 1 can be a chain of aesthetic finish consisting of small beads, which can optionally be associated with coloured plastic chain links for easier handling, for indicating the actual valve position, and for extending the chain.

Fig. 14 shows an adjustable float mount 10 ensuring, in a simple way, the adjustment and position-keeping of the balance float 1 on the link 5 designed as a bead chain as described further above. The float mount 10 includes a rubber sleeve 12 arranged in a housing pipe 13, which is embedded with tight fit, into the balance float 1. An inner bore of the rubber sleeve 12 capable of elastic deformation surrounds the beads of the chain tightly. At its top, the housing pipe 13 is sealed by a fitting plug 11 having a central bore for the chain, and the housing pipe 13 has a threaded bottom closure 14 at its bottom. The bore in the rubber sleeve 12 is selected in a way that by applying a certain force it enables the displacement of the balance float 1 on the bead chain, and thereby the adjustment and readjustment of the appropriate height position of the balance float relative thereto. The float mount 10 can also be designed in a way that a rubber sleeve 12 filling the complete inner length of the housing pipe 13 is used. In such embodiments, the clamping force exerted by the rubber sleeve 12 onto the chain can be increased or adjusted to the

WO 99/14523

PCT/HU98/00084

- 17 -

desirable rate by tightening the threaded bottom closure 14, resulting in a longitudinal compression of the rubber sleeve 12.

Fig. 15 shows another implementation example of the valve assembly embodying the invention, in which the valve means 2 is built in in a common water tap.

Fig. 16 shows as a further example, the sectional view of a valve assembly of the invention, wherein the valve means 2 is installed behind a wall plane. This embodiment includes a cam disc mechanism 3 similar to shown earlier as a schematic kinematic diagram in Figs. 7A and 7B. Here, the cam disc 36 and the actuating lever 31 are designed so that in the lever position shown by a continuous line in the drawing figure they move together, but in the preferentially open position of the valve means 2, the lever 31 can be brought into a vertical position (shown in dotted line in the figure) by tilting around a fulcrum in the disc without actuating the cam disc 36. In such a state of operation, the valve assembly is temporarily out of use in the open position of valve 2.

Fig. 17 shows, by way of example only, a suitable design for simultaneously controlling two (or even more) valves 2a, 2b by a single balance lever 31 and by a balance float (not shown) associated therewith. A further example of simultaneously controlling two valves 2a, 2b by a single balance lever 31 and a balance float 1 associated therewith, is shown in Fig. 18. The mechanism 3 used in this embodiment is similar to that described already with reference to Figs. 6A and 6B further above. Here however, the balance float 1 is connected to the free end of a balance lever 31 which is, at its other end, equipped with a roller 34 capable of rolling on a support surface 35. The changing weight of the balance float acts on a common point of two coupling links 32. Such embodiments of the valve assembly of the invention can preferably be associated with so called mixing valve batteries having separate inlets for cold and warm water, respectively, and the unit comprising the simultaneously controlled two valve means 2 can, because of its relatively slim design, easily be mounted in bath rooms, kitchens and the like between the wall plane and the inlets of mixing valve battery.

It has already been mentioned that thanks to the design and the mode of operation of the valve assembly embodying the invention, even high pressure valves

WO 99/14523

PCT/HU98/00084

- 18 -

with large flow passages as used in industrial applications can be controlled by at least one balance float of small weight and light design. The piston heads 24 used in such valves means 2 generally have a large surface and work against a significant liquid pressure. Preferred embodiments of such piston heads 24 are of the multi-disc structure whereby a gradual opening of the valve means 2 is provided for. A sectional view of an example for such a multi-disc piston head 24 is shown as an elevation, in Figs. 19A to 19C of the attached drawing. Here, the piston head 24 of the valve means 2 consists of two associated discs 241 and 242 of different diameters. Close to its periphery, disc 241 of larger diameter is shaped so as to being suitable for sealingly engaging the valve seat and thus, preventing the liquid from flowing through the valve means 2. The smaller diameter disc 242 located towards the pressure chamber 21 of the valve means 2 is fixed rigidly to the valve shaft 25, while the larger disc 241 is slideably fitted on the valve shaft 25, the fit allowing a limited axial displacement of disc 241 along valve shaft 25. The smaller disc 242 fixed onto the valve shaft 25 has no holes, while the larger disc 241 fitted in a displaceable way on valve shaft 25 has preferably two or more openings 253 in a range within the diameter of the smaller disc 242. Fig. 19A depicts the operational state of the two-disc piston head 24 in its valve closing end position. In this state, the liquid pressure present in the pressure chamber 21 of the valve means 2 maintains the larger disc 241 being pressed against the valve seat, and the smaller disc 242 is pressed against the larger disc 241. The larger disc 241 keeps the flow passage determined by the valve seat of valve means 2 in its sealingly closed state, and the smaller disc 242 keeps the openings 243 of the larger disc 242 closed. The initial phase of valve opening is shown in Fig. 19B. Valve shaft 25 has been slightly displaced to the left, and the openings 243 of disc 241 have been opened so that the liquid is allowed to flow from the pressure chamber 21 into the outlet chamber 22 of the valve means 2, whereby the pressure difference between the valve chambers 21 and 22 is reducing. For the initial displacing the valve shaft 25, that is for initiating the valve opening, only the smaller force generated by the liquid pressure and acting on the smaller surface of piston 242 has to be overcome. As soon as the pressure difference between valve chambers 21 and 22 is nearing and reaches practically at zero, the valve shaft 25 is moved further whereby the larger disc 241

WO 99/14523

PCT/HU98/00084

- 19 -

is removed from the valve seat, the total flow passage of the valve means 2 is opened up and the valve means 2 is moved to its open valve position shown in Fig. 19C. In addition to the design using two discs 241, 242 shown as an example only in the drawing and described above, multi-disc embodiments of the piston head 24 may also be used.

Practical experience has shown that when the valve assembly embodying the invention is applied for preventing the overflow of bath tubs, it may be desirable to add a smaller volume of liquid e.g. hot water to the water content of the tub which has already reached the specified, pre-determined liquid level but cooled off in the meantime or was found insufficiently hot. The implementation examples described would not allow this, because the balance float 1 which has lost its weight by being immersed into the water would, without reducing the water level, not allow for the resetting of the valve means 2 of the valve assembly to its open position. In addition to other advantages, a replenishing at unchanged water level is enabled by making use of a further preferred embodiment of the valve assembly of the invention, as shown in Fig. 20. In this embodiment, valve means 2 and mechanism 3 of the valve assembly are fitted upstream of the valve battery 6 of a bath tub 60 protected against overflow. By means of a bottom connecting pipe 42 utilising the principle of communicating vessels, the liquid content of the bath tub 60 is in communicating connection with an auxiliary receptacle 44, the cross-sectional area and the volume of which are much smaller than that of the bath tub 60. In its bottom range, the auxiliary receptacle 44 has a discharge orifice 47 closed by a valve 46, which can be opened by activating a release lever 45 manually. For reasons of hygiene, the bottom connecting pipe 42 includes check valve 43 which excludes the possibility of water flowing back from the auxiliary receptacle 44 into the bath tub 60. The internal cross section of the connecting pipe 42 is much smaller than the cross section of the discharge opening 47, and the balance float 1 is arranged above the auxiliary receptacle 44 whereby the balance float 1 controls the liquid level in the bath tub 60 by immersing in the liquid contained in the auxiliary receptacle 44 while the bath tub is being filled with water flowing through the valve means 2 in its open state. In this embodiment a further significant advantage is seen in that the valve assembly embodying the invention is fully hidden, i.e. concealed because the

WO 99/14523

PCT/HU98/00084

- 20 -

auxiliary receptacle 44 and the accessories associated therewith can all be arranged behind the wall plane. Practically, only the valve battery 6 and an end portion of the release lever 45 are exposed in the bathroom. The mode of operation of the embodiment of the invention shown in Fig. 20 is the following:

During the relatively slow filling of the bath tub 60, the auxiliary tank 44 is also filled up to an identical level through the narrow cross section connecting pipe 42. When the pre-determined water level is reached, the balance float 1 immersing into the water in auxiliary receptacle 44 loses its weight, the valve assembly according to the invention is actuated, and the water flow from the delivery duct 7 to the valve battery 6 becomes blocked by valve means 2. If it is desired to fill a further volume of water into bath tub 60, the valve 46 is opened by actuating the release lever 45 and the water is rapidly released from the auxiliary receptacle 44 through the discharge opening 47 of large cross section. The water level in the auxiliary receptacle 44 quickly decreases because due to the difference in cross sections, it can only be filled up slowly via connecting pipe 42. As a result of the rapid reduction of the water level in the auxiliary receptacle 44, the balance float 1 leaves the liquid, and by regaining its weight, it resets, at least temporary, the valve means 2 of the valve assembly into its open state, whereby an additional amount of preferably hot water is allowed to flow into the bath tub 60 through valve means 2. By stopping the actuation of the release lever 45 the valve 46 of the auxiliary receptacle 44 is closed, and latter is relatively slowly refilled up to the water level of the bath tub 60 through the narrow connecting pipe 42. The balance float 1 is immersed into water again, and by means of the associated mechanism 3, it moves the valve means 2 into its closed valve state again.

Finally, in Figs. 21 to 23 of the attached drawing, further important applications and installations of the valve assembly of the invention are shown, by way of examples. The balance float controlled valve assembly according to the present invention can be very advantageously designed and used as a „flood guard” monitoring the leakproof condition of a liquid supply system of premises, workshops or other buildings. The „flood guards” shown in Figs. 21 to 23 is automatically monitoring and shuts off the delivery duct or certain branches thereof when detecting a leakage or flooding within the system.

WO 99/14523

PCT/HU98/00084

- 21 -

With the embodiment depicted in Fig. 21, the valve means 2 of the valve assembly is fitted into a liquid, especially water supply delivery duct 7 of a so-called „sanitary block” of a building. A liquid receptacle 4 of the valve assembly is arranged at a deep point of a floor 8 of the room, as a recess open at the top, for collecting liquid, especially water leaking from the supply system as a result of pipe breakage or any other sealing failure. The balance float 1 of the valve assembly is fixed to the bottom end of the link 5 that is surrounded by tubular protecting cover 50 which at least optionally can be embedded in a wall of the room or building. Based on the description of the operation of several embodiments of the invention further above, it can be seen easily that if as a result of pipe breakage or another sealing failure, liquid appears and collects in the liquid receptacle 4 recessed into the floor 8, the balance float 1 is immersed into the liquid, and through the mechanism 3 the valve means 2 of the valve assembly is moved into its closed valve position whereby the delivery duct 7 is blocked and any further liquid flow or leakage is stopped automatically until the failure is detected and remedied. Optionally, the “flood guide” can also be associated with any suitable signalling device generating suitable audible and/or visible or other signals when having detected a sealing failure in the supply system and the valve means 2 has been actuated.

Fig. 22 shows another arrangement of the „flood guard” described above, wherein due to given local circumstances or the given route of the delivery duct 7, the valve means 2 can not be arranged above the liquid receptacle 4 recessed into the floor 8. Here, the flexible link 5 holding the balance float 1 comprises several strands along its route between the valve means 2 and the balance float 1, and at least some of the strands of the flexible link 5 are, at least partially and optionally again, surrounded with a preferably tubular protecting cover 51. Between the strands the flexible link 5 is guided around preferably freely rotatable pulleys 51. In certain applications, the whole floor section of a room or building can serve as liquid receptacle of the valve assembly. In such applications the balance float of the “flood guard” valve assembly is arranged in the very proximity of the floor level of the room or building for actuating the valve assembly when a certain, preferably low level of liquid is sensed on the floor.



WO 99/14523

PCT/HU98/00084

- 22 -

Finally, Fig. 23 shows another embodiments of the valve assembly of the invention, which are installed and applied as a „flood guard” again, in the water supply system of multi-storey buildings. In these embodiments a balance float 1 is rigidly connected to the end of the balance lever 31. The valve means 2 of one of the valve assemblies shown in the drawing figure is installed behind a flow meter 9 into a liquid, preferably water supply delivery duct 7 introduced through the cellar or basement of a multi-storey building, while the valve means 2 of the another valve assembly is mounted into a branch 71 of the delivery duct 7, supplying for example, a bathroom on the ground floor of the building. The liquid receptacles 4 shown are fitted with a removable cover grid 48 for the purpose of emptying and cleaning. The liquid receptacles 4 collect the liquid, especially water leaking from the supply system as a result of pipe breakage or other sealing failure. Liquid receptacles 4 are recessed into floors 8 of the various levels, and the „flood guard” valve assemblies embodying the invention and protecting each level separately against flooding have valve means 2 controlled by balance floats 1 that are rigidly connected to the rotatable free end of the balance lever of the respective valve assembly. The valve assembly is mounted into sections of the delivery duct 7 and the branching 71 respectively, which sections intersect and are located within a respective liquid receptacle 4. In order to prevent serious damage resulting from flooding, valve assemblies of the invention can be applied as a „flood guard” on each level of a multi-storey building, especially at locations where the risk of flooding prevails.

The major advantages of the valve assembly embodying the invention can be summarised as follows:

The rate of closing and opening the valve means does no more depend on the rate of change in the liquid level. The mode of operation and the dynamic characteristics of the valve means can be influenced by appropriate design and dimensioning of the balance float(s), the valve means and the motion-transmission mechanism. The opening and closing characteristics of the valve may be different.

The valve assembly can be designed both, a one-way structure capable of automatically closing the valve means only, and as a two-way assembly which is equally able to close and reopen the valve means depending on the liquid level. Therefore, the extremely wide field of application reaches from the safety „flood

WO 99/14523

PCT/HU98/00084

- 23 -

guard" function preventing overflow or flooding, to the valve assembly of the invention performing even liquid level control in various industrial plants. Embodiments equipped and operating with two or more suspended balance floats enable the controlled or regulated keeping of especially large level differences.

Valve means having extremely large flow passages can be controlled by at least one low weight balance float, and the valve means may also be remotely located and/or distant from the liquid receptacle. The valve assembly can be so designed that the mechanism is under significant load during the closing and opening of the valve means only.

The valve assemblies of the invention are of relatively simple design, of small size, compact design when compared to their flow passage and of long life when compared to their performance. Embodiments of the invention intended for use in bathrooms can be made at least partly concealed while their exposed parts and embodiments can be designed so as to appear as high standard aesthetic armatures and fittings.

WO 99/14523

PCT/HU98/00084

- 24 -

## List of Reference Signs of the Drawings

balance float	1, 1a, 1b	
float mount		10
fitting plug		11
rubber sleeve		12
housing pipe		13
bottom closure		14
valve means	2, 2a, 2b	
flow passage		20
pressure chamber		21
outlet chamber		22
closure member		23
piston head		24
disc		241, 242
opening		243
valve shaft		25
sleeve		26
casing		27
flow strainer		28
sound signal device		29
mechanism	3	
compression spring		30
balance lever		31
coupling link		32
slotted link bar		33
roller		34
support surface		35
cam disc		36
bushing		37
liquid receptacle	4	
outlet valve		41
connecting pipe		42
check valve		43
auxiliary receptacle		44
handle bar		45
valve		46
discharge opening		47
cover grid		48
link	5	
protecting cover		50
pulley		51
valve battery	6	
bath tub		60
discharge orifice		61
delivery duct	7	
branching		71
floor	8	
flow meter	9	

WO 99/14523

PCT/HU98/00084

- 25 -

## Claims

1. A balance float controlled valve assembly which includes at least one valve means installed into a liquid flow, especially into a pipeline or a pipeline armature, a liquid receptacle that is fed with at least a part of the liquid flowing through the valve means or escaping, as a result of a sealing failure, from a liquid supply system including said at least one valve means, the valve assembly further including at least one balance float connected to a rotatable free end of a pivoted balance lever, said at least one balance float staying substantially above the current liquid level of the liquid in the receptacle while said liquid level is below a pre-determined or permitted level while the balance float immersing, at least partially, into the liquid contained in the receptacle when said liquid level reaches or exceeds said pre-determined or permitted level in said receptacle, said valve means comprising a flow passage determined by a valve seat that is arranged between a pressure chamber and an outlet chamber of the valve means, said valve means further comprising a piston-like closure member having a valve shaft and a piston head at one end of said valve shaft, the valve shaft being slideably guided between a first end position and a second end position, said closure member maintaining a thoroughfare flow passage through said valve means in the first end position of the valve shaft, and the closure member closing the flow passage through said valve means when said valve shaft is moved to its other, second end position, the piston head of said closure member being arranged within the pressure chamber of the valve means and the valve assembly further including a mechanism arranged between the balance lever and the valve shaft of the closure member of said valve means, the valve assembly being characterised in said mechanism (3) being designed so as to having and staying in an at least approximately self-locked state when the valve shaft (25) of the closure member (23) of the valve means (2, 2a, 2b) stays in its first end position, said at least approximately self-locked state of the mechanism being substantially resistant to forces exerted onto and biasing said valve shaft (25) towards its second end position in the sense of closing the thoroughfare flow passage through said valve means (2, 2a, 2b), but said at least approximately self-locked state of the mechanism being easily releasable by the

WO 99/14523

PCT/HU98/00084

- 26 -

balance lever (31) when the torque exerted onto the balance lever (31) by the weight of the at least one balance float (1, 1a, 1b) is slightly reduced, and said balance lever (31) is lifted and turned in a direction opposite to the torque exerted thereon by said at least one balance float (1, 1a, 1b).

2. The valve assembly as claimed in claim 1, characterised in said at least one balance float (1, 1a, 1b) having a density that is identical with or lower or higher than that of the liquid, said at least one balance float (1, 1a, 1b) optionally being divided into several internal compartments or sections, said optional internal compartments or sections of the at least one balance float (1, 1a, 1b) being made of or filled in with different structural materials of different density.

3. The valve assembly as claimed in claim 1 or 2, characterised in that the at least one balance float (1, 1a, 1b) is linked to the rotatable free end of the balance lever (31) by means of a preferably flexible link suitable for bearing and transferring tensile load, and that the mechanism (3) also includes an energy-storing spring means, preferably at least one pre-tensioned compression spring (30), said spring means biasing the closure member (23) of the valve means (2, 2a, 2b) in the direction of its second end position corresponding to the closed state of said valve means (2, 2a, 2b).

4. The valve assembly as claimed in claim 3, characterised in that the at least one balance float (1, 1a, 1b) is arranged at any suitable location relative to the at least one valve means (2, 2a, 2b), the at least one balance float (1, 1a, 1b) being suspended above the liquid receptacle (4) in adjustable relation thereto, and several balance floats (1a, 1b) arranged optionally on and held by the same link (5) are positioned at adjustable distances in relation to both, each other and the receptacle (4).

5. The valve assembly as claimed in any one of claims 1 to 4, characterised in that the pressure chamber (21) of the valve means (2, 2a, 2b) or a delivery duct section or armature member connected or associated directly to said pressure

WO 99/14523

PCT/HU98/00084

- 27 -

chamber (21) comprises a compressible component part capable of elastic deformation, said compressible component part being preferably a deformable lining or a bushing (37) fitted into an inlet section of said pressure chamber (21).

6. The valve assembly claimed in any one of claims 1 to 5, characterised in that it includes several, preferably two valve means (2a, 2b) each of them being controlled by the same at least one balance float (1) linked to one single balance lever (31).

7. The valve assembly set as claimed in any one of claims 1 to 6, characterised in the liquid receptacle (4) being preferably a bath tub (60), the valve assembly further including an of relatively small cross-sectional area and of substantially smaller volume relative to those of the bath tub (60), said auxiliary receptacle (44) being, via a connecting pipe (42), in at least one way permanent liquid communication with the bath tub (60) by making use of the principle of communicating vessels, the auxiliary receptacle (44) having at its bottom, a discharge opening (47) normally closed by a valve (46) openable by actuating, preferably manually, a handle bar (45), the connecting pipe (42) optionally includes a check valve (43) preventing the flow of liquid from the auxiliary receptacle (44) back to the bath tub (60), the inner cross section of the connecting pipe (42) being much smaller than that of the discharge opening (47) and the balance float (1) being assigned to the auxiliary receptacle (44) so that the liquid level prevailing in the bath tub (60) is controlled by the balance float (1) as a function of the liquid level in the auxiliary receptacle (44) via the valve means (2) which supplies the bath tub (60).

8. The valve assembly as claimed in any one of claims 1 to 7, characterised in the liquid receptacle being preferably a bath tub (60), and the at least one valve means (2, 2a, 2b) being associated with a valve battery (6) supplying the bath tub (60) by said at least one valve means (2, 2a, 2b) being mounted into each delivery duct (7) supplying the valve battery (6), or into a discharge orifice (61) or into a strainer (28) connected to the discharge outlet (61) of the valve battery (6), said

WO 99/14523

PCT/HU98/00084

- 28 -

valve means (2) being preferably mounted by means of a releasable coupling, between the discharge outlet (61) and strainer (28) to existing valve batteries (6).

9. The valve assembly as claimed in claim 1 characterised in the balance float (1) being rigidly connected to the rotatable free end of the balance lever (31), the valve assembly being mounted into a section of a delivery duct (7) which section is located intersecting a liquid receptacle (4) recessed preferably into the floor (8) of a building or at least one room of a building, said liquid receptacle being designed and arranged for collecting liquid, especially water escaping, as a result of a pipe breakage or other sealing defect, from the liquid, especially water supply system of the building.

10. The valve assembly as claimed in claim 2, characterised in said at least one valve means (2) being installed into a delivery duct (7) and/or into at least some delivery duct branches (71) delivering a liquid, especially water into a liquid supply system of a building, at least one liquid receptacle (4) being recessed, preferably at a deep point of the building or a building level into the floor (8) of said building or building level, said at least one liquid receptacle(s) (4) serving for collecting liquid, especially water escaping, as a result of a pipe breakage or another sealing defect, from said liquid supply system, each of said liquid receptacles (4) being assigned a balance float (1) moving the at least one normally open valve means (2) to its closed position when a pre-determined, specified liquid level is reached in said liquid receptacle (4), said balance float (1) being connected to the appropriate associated valve means (2) via a flexible link (5), said flexible link (5) being, at least optionally, guided around preferably freely rotatable discs or pulleys (51) whereby said flexible link (5) comprises several strands along its route between said valve means (2) and said balance float (1), and at least some of said strands of said flexible link (5) being, at least partially and optionally again, surrounded with a preferably tubular protecting cover (51).

11. The valve assembly as claimed in claim 4, characterised in said mechanism (3) being capable of transferring motion between the balance lever (31)

WO 99/14523

PCT/HU98/00084

- 29 -

and the valve shaft (25) of the piston-like closure member (23) in both senses of displacement of the latter, and the transmission ratio of said mechanism (3) being, in association with the number, density, weight and shape of the balance floats (1a, 1b), and the characteristics of the optional spring means, especially compression spring (30), selected and designed so that said mechanism is capable of closing a flow passage (20) of the open valve means (2) by moving the closure member (23) of the valve means (2) from its first end position to its second end position when at least one of the balance floats (1a, 1b) is at least partially immersed in the liquid contained in the liquid receptacle (4), and said mechanism (3) is also capable of re-opening the closed flow passage of the closed valve means (2) by moving the closure member (23) of said valve means (2) from its second end position to its first end position when at least one balance float (1a), preferably when also the lowest balance float (1b) at least partially emerges from the liquid contained in the liquid receptacle (4).

12. The valve assembly as claimed in claim 1 or 11, characterised in the piston head (24) of the closure member (23) of the valve means (2) consisting of several discs (241, 242) of different diameters assigned to one another, the disc (241) of largest diameter being designed and shaped so as to being capable of providing a sealed closure between its quasi-peripheral or peripheral range and a valve seat of said valve means (2), the remaining discs (242) having diameters gradually decreasing towards the pressure chamber (21) of the valve means, the disc (242) of smallest diameter being fixed in a rigid way to the valve shaft (25), the other discs (241) being allowed of limited displacement along the valve shaft (25) in the direction of latter, the smallest disc (242) fixed on the valve shaft (25) having no openings, while each remaining disc (241) guided in a displaceable way along the valve shaft (25) having at least one opening (243), said at least one opening (243) being located in the disc (241) within an area the diameter of which is smaller than the diameter of the next neighbouring smaller disc (242).



WO 99/14523

PCT/HU98/00084

1/6

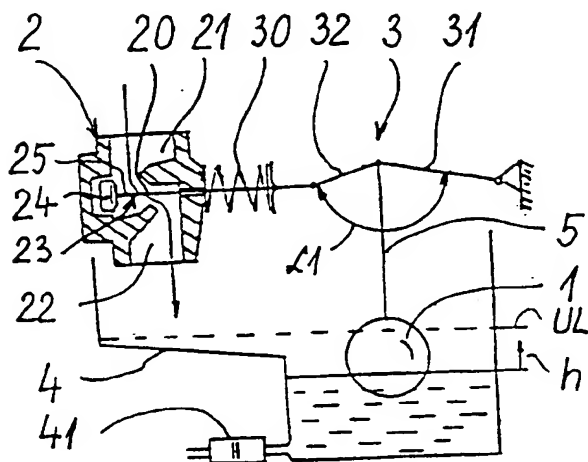


Fig. 1A

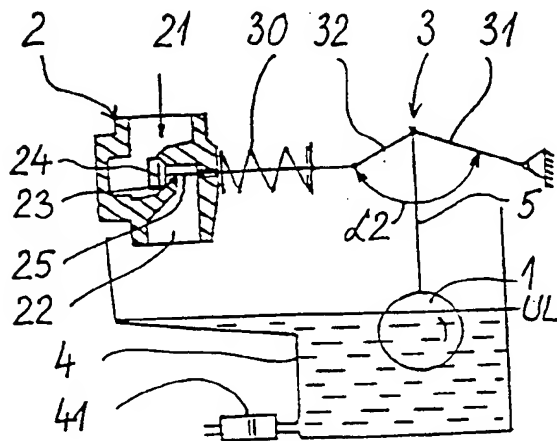


Fig. 1B

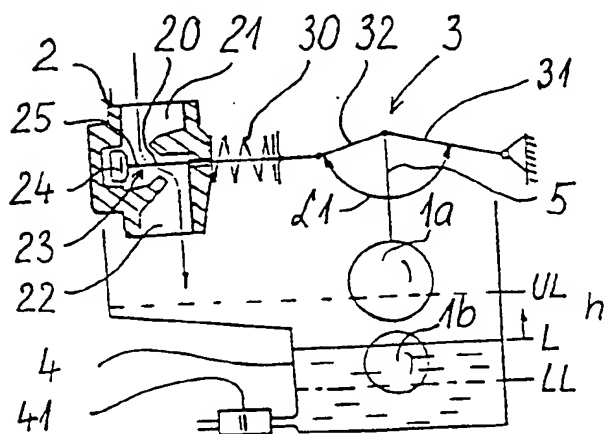


Fig. 2A

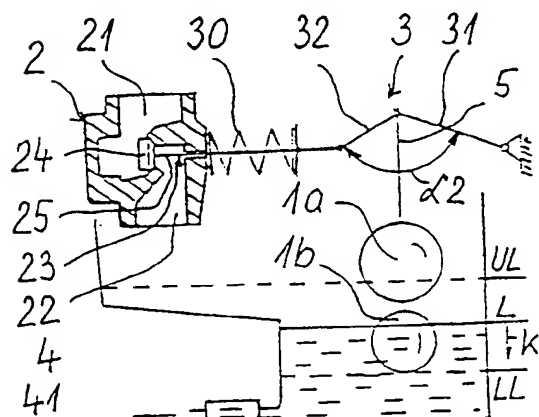


Fig. 2B

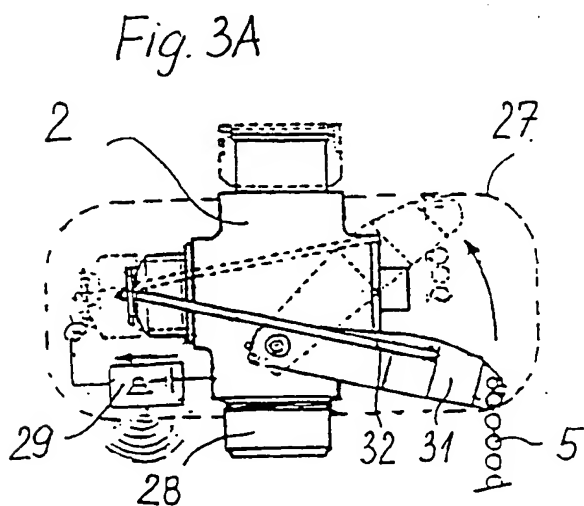


Fig. 3A

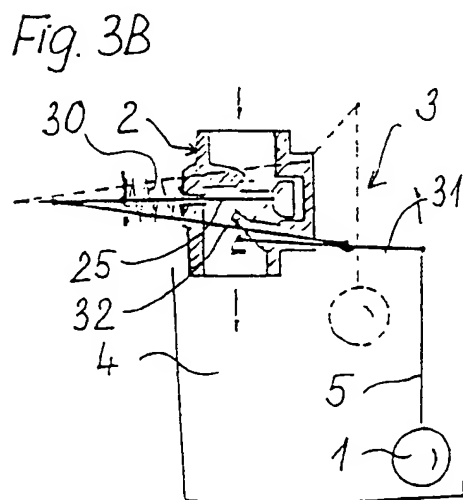


Fig. 3B

WO 99/14523

PCT/HU98/00084

2/6

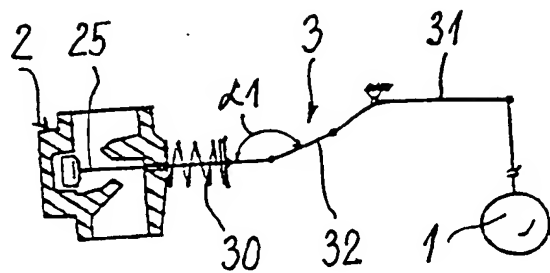


Fig. 4A

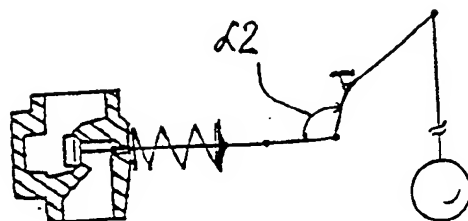


Fig. 4B

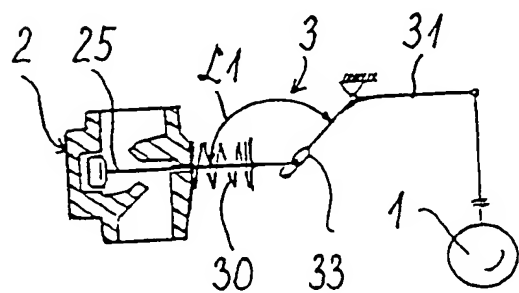


Fig. 5A

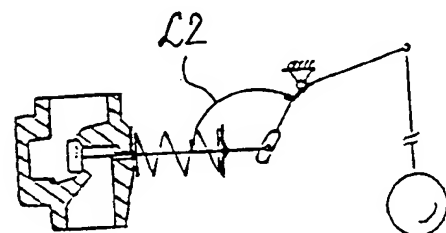


Fig. 5B

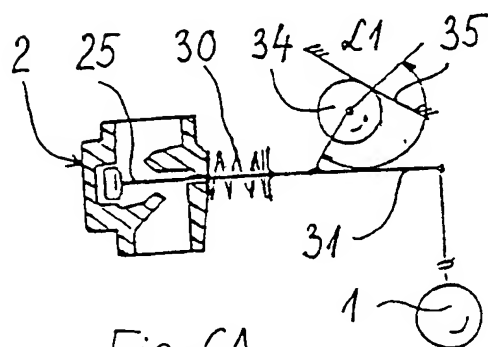


Fig. 6A

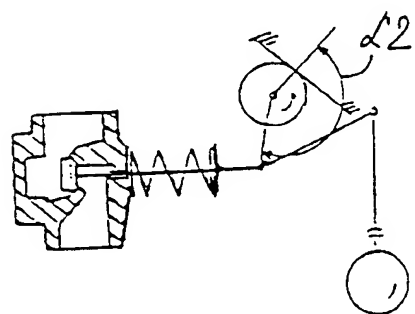


Fig. 6B

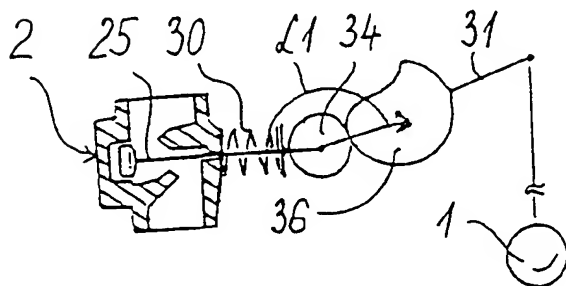


Fig. 7A

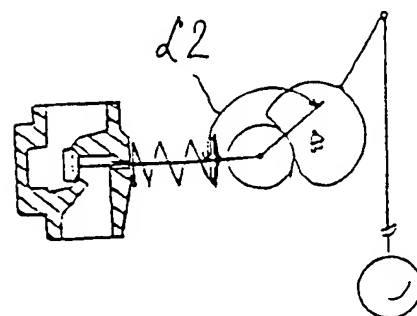


Fig. 7B

WO 99/14523

PCT/HU98/00084

3/6

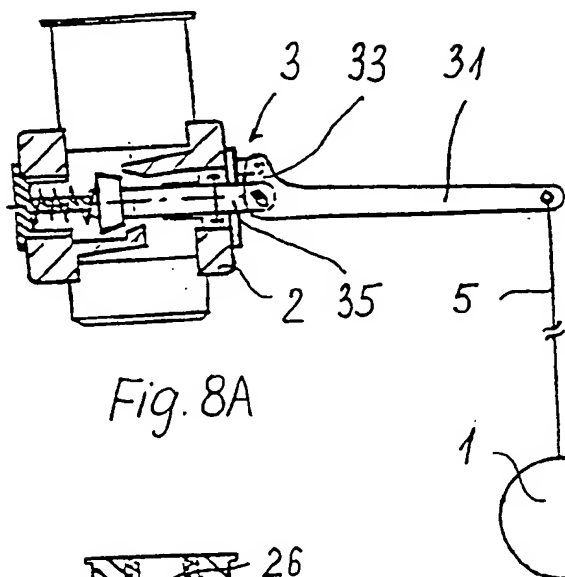


Fig. 8A

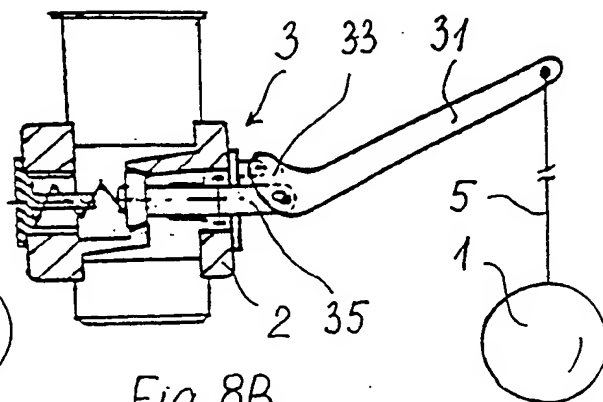


Fig. 8B

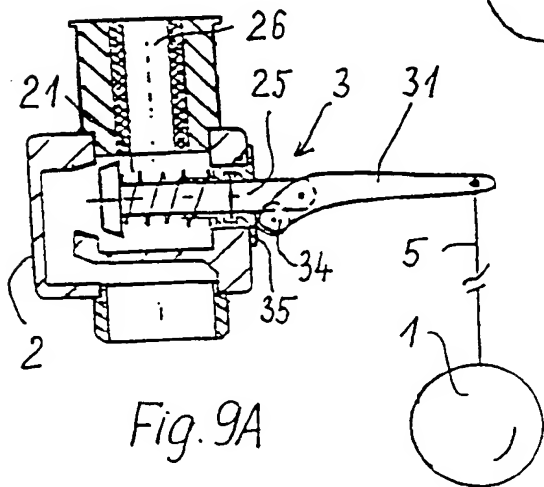


Fig. 9A

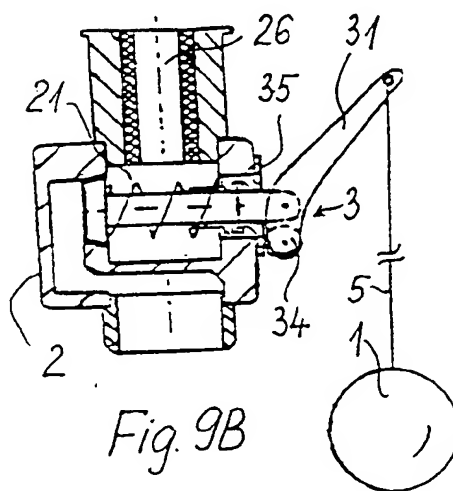


Fig. 9B

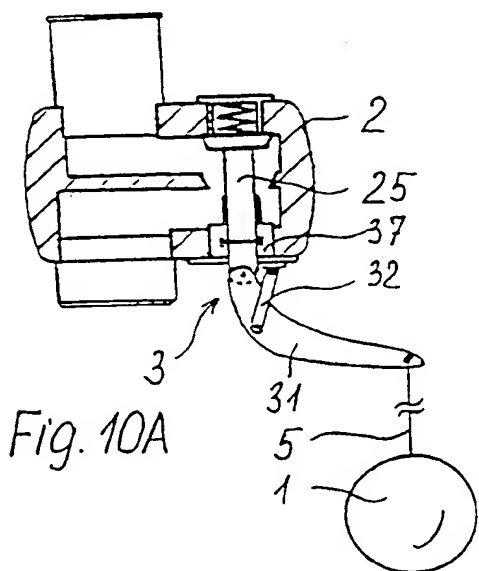


Fig. 10A

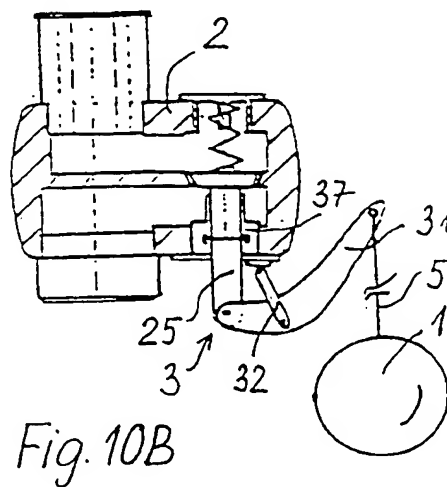
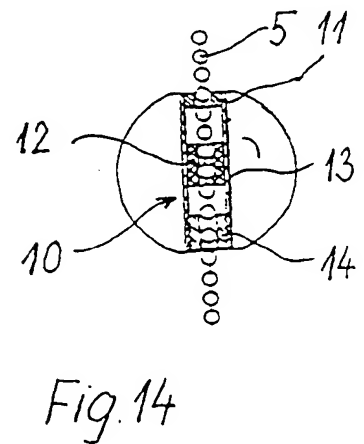
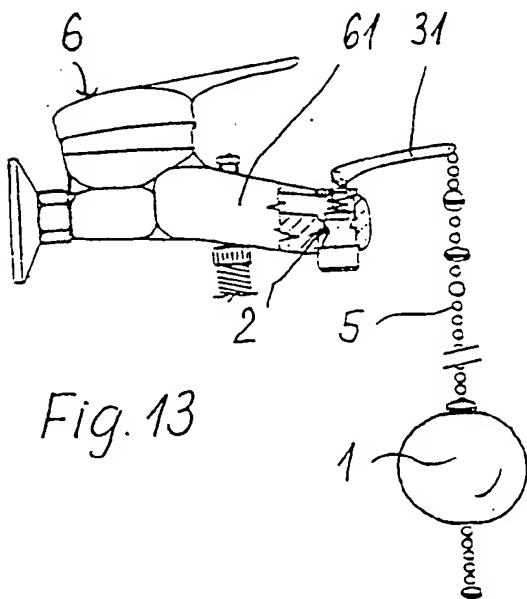
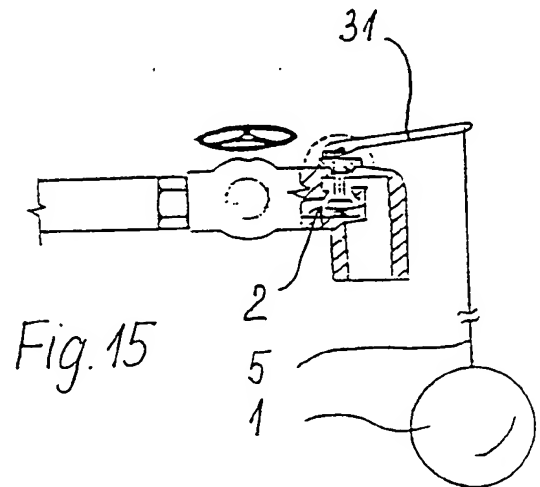
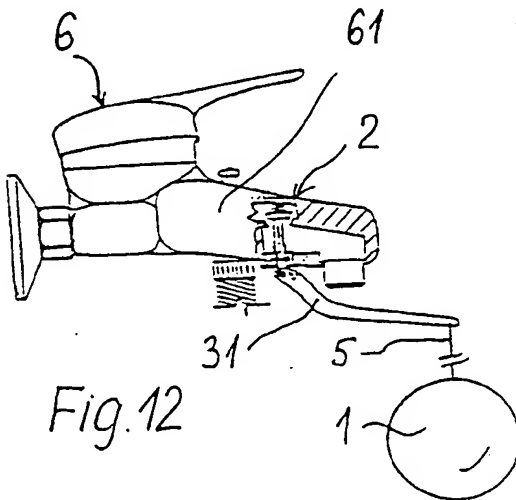
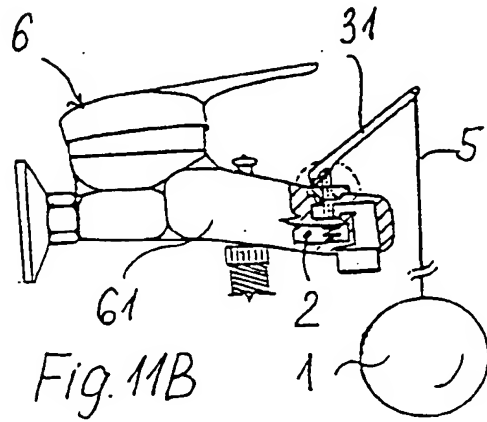
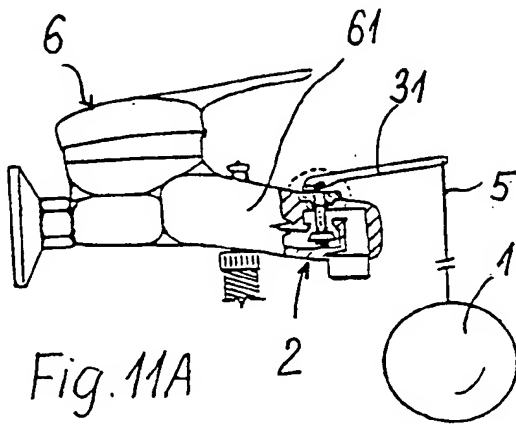


Fig. 10B

WO 99/14523

PCT/HU98/00084

4/6



WO 99/14523

PCT/HU98/00084

5/6

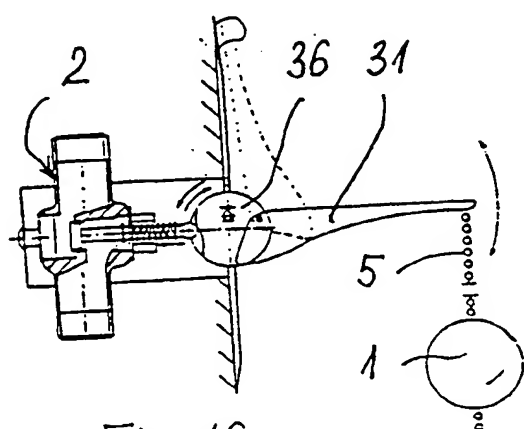


Fig. 16

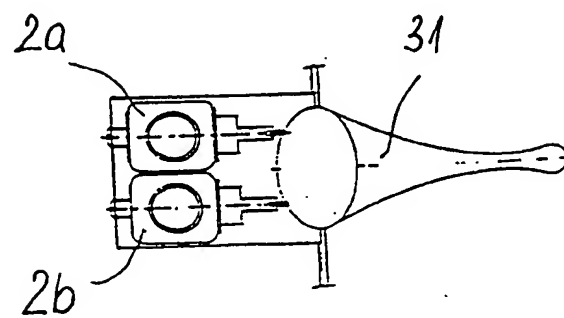


Fig. 17

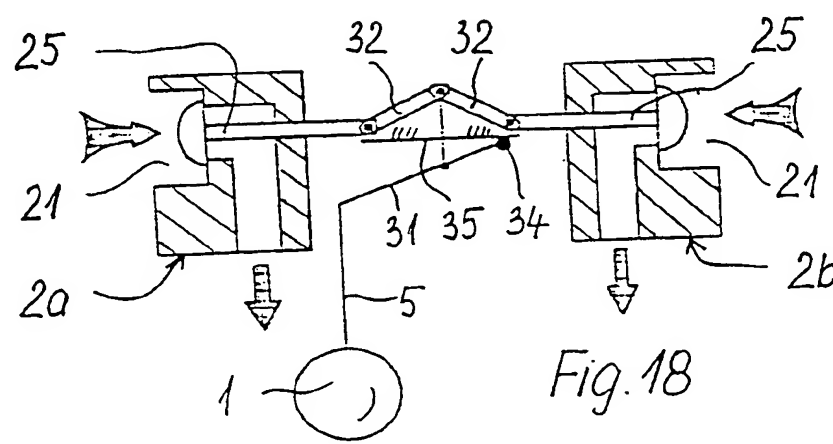


Fig. 18

Fig. 19A

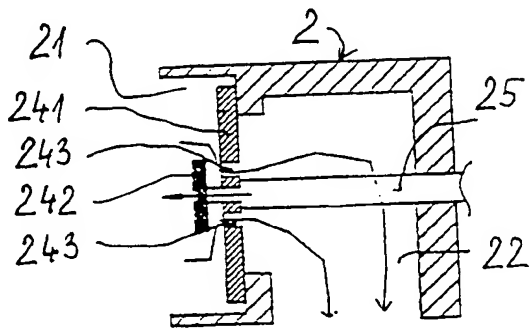
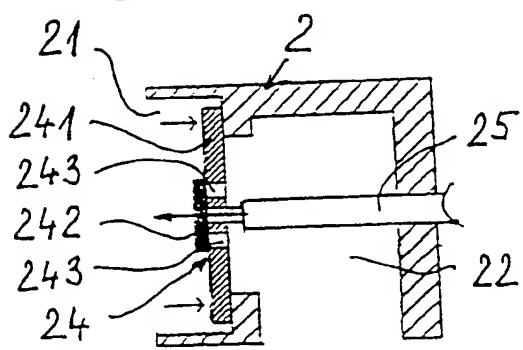


Fig. 19B

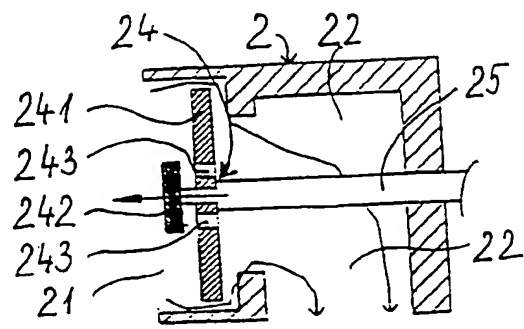


Fig. 19C

WO 99/14523

PCT/HU98/00084

